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WINTER HOME RANGES OF 4 CLANS OF RED-COCKADED WOODPECKERS IN THE CAROLINA SANDHILLS

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The behavior and ecology of the Red-cockaded Woodpecker (*Picoides borealis*) have been of interest to ornithologists for a number of years (Murphy 1939). However, only recently have these aspects of the biology of the woodpecker been studied in any detail (Lay and Russell 1970, Ligon 1970, Thompson 1971, Hooper, Lennartz and Harlow [paper given at Wilson Soc. meeting 19–21 May 1977]). Red-cockaded Woodpeckers live in clans consisting of a mated pair, their offspring and associated helpers (Ligon 1970). Nesting and roosting cavities of these woodpeckers usually are constructed in living pine trees infected with red-heart disease (*Phellinus pini*) (Steirly 1957).

The amount of space used by Red-cockaded Woodpecker clans varies. Crosby (1971) found a mean of 17.2 ha for home ranges of 2 clans in March–June in northcentral Florida. The territory of 1 clan in Georgia was estimated to be 65.6 ha (Baker 1971). Skorupa and McFarlane (1976) studied seasonal variation in the foraging territories of 2 clans in South Carolina and found maximum territory sizes of 48.3 ha and 65.8 ha during the month of January. The mean winter territories of 6 clans in the coastal plains of South Carolina was 64.8 ha (Hooper et al., unpubl.) Nesbitt et al. (1978) reported an average range of 69.8 ha for 4 clans in central Florida during October–December.

The purpose of our study was to determine the area used by 4 clans of Red-cockaded Woodpeckers in the Carolina Sandhills during the winter of 1977–1978 and to examine the influence of clan size and interclan pressures on the spacing of the clans.

STUDY AREA AND METHODS

Four clans of Red-cockaded Woodpeckers were observed during December 1977, January and February 1978 at the Carolina Sandhills National Wildlife Refuge, South Carolina. The predominant habitat in the approximately 161.8-ha study area was longleaf pine (*Pinus palustris*) with a scrub oak (*Quercus laevis* and *Q. marilandica*) understory. The longleaf pine in the study area included sawtimber (DBH > 22.86 cm) and pulpwood (DBH = 10.16–22.60 cm). Approximately 8.00 ha contained only longleaf pine of sawtimber size and no understory. These 8.00 ha were centrally located. On the western border of the study area there were several bodies of water, 3 small ponds which ranged in size from 0.80–1.33 ha and one 12.14-ha lake. Wet areas containing pond pine (*Pinus serotina*) scattered longleaf pine and a dense hardwood understory (various spp.) surrounded the ponds and lake.

Clan members were uniquely color banded during the first week in January. Clan 1 consisted of 8 birds, with 5 males and 2 females banded. Clan 2 had 4 birds and 2 males were banded. During the majority of the observation period, clan 3 included a banded pair. On several days during January, 2 other Red-cockaded Woodpeckers were seen foraging with clan 3. No apparent agonistic encounters between the non-resident birds and the home pair were seen; however, the 2 non-resident birds never roosted within the range of clan 3. Clan 4 consisted of 4 birds, of which a male and female were banded.

On each day of observation, 1 clan was selected and followed for the remainder of the day. Total days and hours of observation for each clan were as follows: clan 1—10 days (39 h), clan 2—15 days (33 h), clan 3—14 days (37 h), and clan 4—11 days (40 h). Observation days for each clan were distributed randomly throughout the 3-month study. The time of day when a clan was observed depended on when the clan was first spotted and weather conditions. Location of the clan was plotted on a grid map at 5 min intervals throughout each observation period. Grid maps were made by placing a grid (1 block = 10 ha) over aerial photographs and other available maps of the refuge.

Observation points for all days were plotted on 1 map for each clan (clan 1—471 observation points; clan 2—451 observation points; clan 3—457 observation points; clan 4—488 observation points). The size of the area used by each clan during the duration of the study was then calculated by connecting all peripheral points and measuring the area within these points.

Locations of cavity trees within and adjacent to the home ranges were plotted. Distances from the peripheral cavity trees of a clan to the peripheral cavity trees of all adjacent clans were measured. Also, distances from the nest cavity of a clan to the nest cavities of adjacent clans were measured. Locations of nest cavities used by various clans in the spring of 1978 were determined, with the exception of clan 4, by observations of the refuge forester, David Robinson, and authors. The nest cavity used by clan 4 was not observed and there is a possibility that they may not have nested in 1978. However, from activities around the cavity trees during our study and from later observations by David Robinson we feel that the cavity tree circled (⊙) for clan 4 in Fig. 1 had the highest probability of being the 1978 nest cavity, if one was present. Finally, the agonistic interactions between clans were recorded and the locations of disputes were plotted on the maps. The agonistic encounters generally consisted of members of 2 clans giving the SHE-U call (Ligon 1970). A few instances of chasing and wing boxing were recorded.

Standard parametric statistical methods were used for computing means and standard deviations of distances among cavity trees of all clans. Simple linear correlations were computed to determine relationships between home range size and other parameters measured in the study (Steel and Torrie 1960:183).

RESULTS AND DISCUSSION

The mean home range of the 4 clans was 31.2 ha (clan 1—43.7 ha; clan 2—20.6 ha; clan 3—20.7 ha; clan 4—39.9 ha). A diagrammatic representation of the areas occupied by the 4 clans is shown on Fig. 1.

According to Wilson's (1975) classification of social spacing, a home range is an "area that an animal learns thoroughly and habitually patrols" and a territory is an "area occupied more or less exclusively by an animal or group of animals by means of repulsion through overt defense or advertisment." Terminology used to describe the social spacing of Red-cockaded Woodpeckers has varied. Ligon (1970, 1971), Lay and Russell (1970)

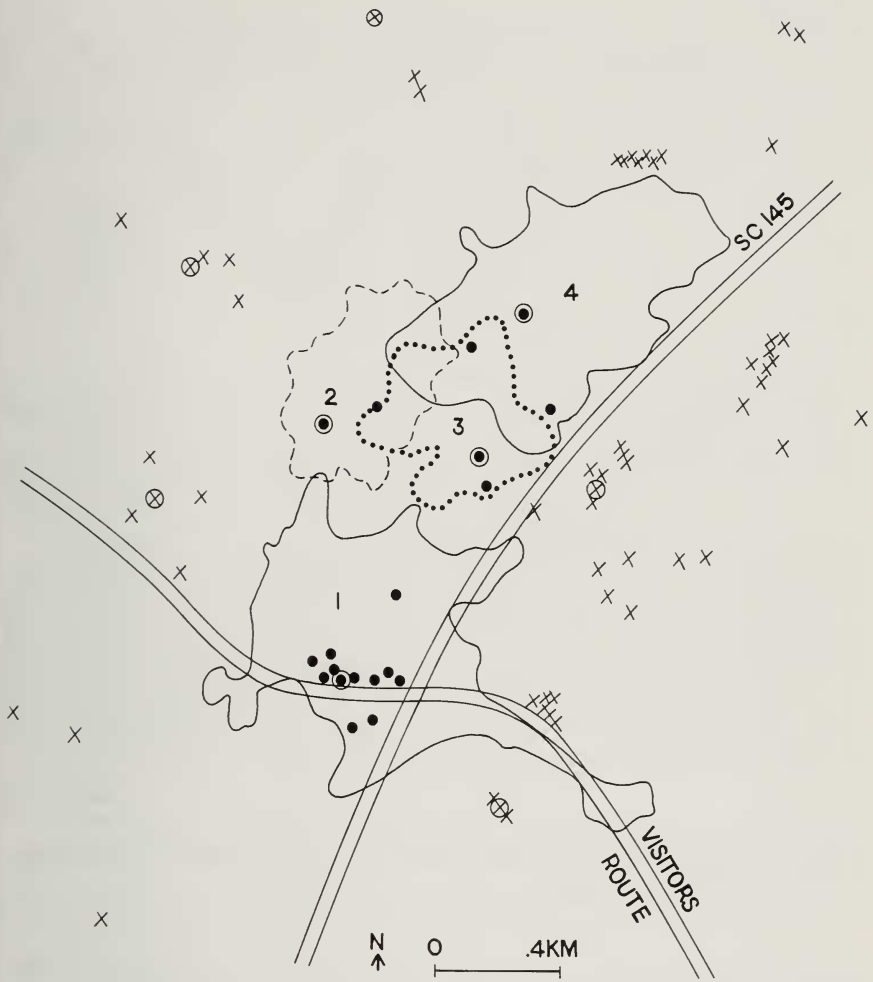

FIG. 1. Home ranges of 4 clans of Red-cockaded Woodpeckers. Symbols are as follows: ● = cavity trees, ⊙ = nest trees (1978), × = cavity trees of neighbors, ⊗ = nest trees of neighbors.

and Baker (1971) used the term "territory" to describe the red-cockaded's social spacing. Crosby (1971) appeared to use the terms home range and territory interchangeably, while Hooper et al. (unpubl.) distinguished between territories and home ranges of red-cockaded clans. They indicated that the home range was larger than the territory in all clans studied; however, the difference between the size of the home range and the territory was variable. We have classified the 4 areas occupied by the clans

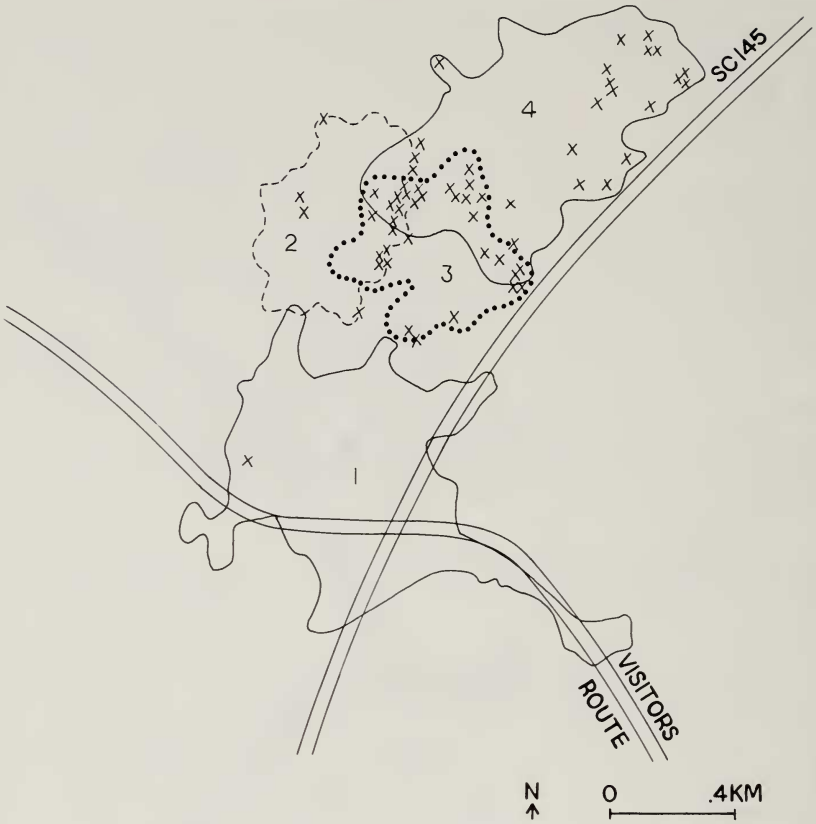

FIG. 2. Location of agonistic encounters of 4 clans of Red-cockaded Woodpeckers. X represents 1 agonistic encounter.

of this study as home ranges rather than territories for 2 reasons. First, the areas used by clans 2–4 overlap, indicating that parts of the ranges of these 3 clans are shared by 2 or more clans (see Fig. 1). Secondly, no well-defined defense perimeter was apparent in the 4 clans with the possible exception of clan 3 (Fig. 2). Therefore, the results of this study do not present sufficient evidence to justify classifying the areas occupied by the 4 clans as territories. Further study may indicate that these 4 clans occupy a home range and defend a smaller territory within the home range as reported by Hooper et al. (unpubl.) for clans at Francis Marion National Forest.

The average size of home ranges reported here is within the size variation of areas occupied by other Red-cockaded Woodpecker clans (Lay

TABLE 1
TOTAL AGONISTIC ENCOUNTERS OBSERVED IN 4 CLANS DURING STUDY

Clan	1	2	3	4
Total h observation/clan	39	33	37	40
		No. agonistic encounters		
December	0	0	2	2
January	0	6	5	7
February	1	6	5	5
Total	1	12	12	14

and Russell 1970, Crosby 1971, Baker 1971, Skorupa and McFarlane 1976, Hooper et al., unpubl.). The closest correspondence was found between our results and the results for 4 clans located in predominantly longleaf pine areas at Francis Marion National Forest, which had winter home ranges of 22.6–28.7 ha (Hooper, pers. comm.).

As suggested by Hooper et al. (unpubl.), the size of the area used by a red-cockaded clan may be related to the size of the clan, interclan pressures and the type of habitat. We looked at some aspects of the first 2 factors in relation to home range size. No significant relationship was found between the number of birds in the 4 clans and the size of the home range used by each clan ($r = 0.75$, NS). Hooper et al. (unpubl.) also reported finding no striking relationship between clan size and territory size, but stated that more data were needed before any conclusions could be drawn.

We analyzed the influence of interclan pressures on the size of the home ranges of the 4 clans using 3 criteria: (1) agonistic encounters between clans (Table 1); (2) average distances to peripheral cavity trees of surrounding clans (Table 2); and (3) average distances to nest cavities of neighboring clans (Table 2).

During observations clan 1 was seen to be involved in only 1 agonistic

TABLE 2
MEANS AND SD OF DISTANCES TO NEIGHBORING CAVITY TREES AND NEST CAVITIES

	Ave. distances to neighboring cavity trees (m)	Ave. distances to neighboring nest cavities (m)
Clan 1	560 ± 133	770 ± 132
Clan 2	480 ± 153	590 ± 123
Clan 3	295 ± 106	500 ± 185
Clan 4	560 ± 284	720 ± 267

interaction with another clan, while clans 2, 3 and 4 were involved in 12, 12 and 14 encounters respectively. The sites of the agonistic encounters for each clan are shown in Fig. 2. No significant correlation was found between home range size and the number of agonistic encounters ($r = -0.55$, NS); however, there seems to be a tendency for clans with larger home ranges to be involved in fewer encounters. Also the greatest numbers of conflicts occurred where the home ranges overlapped (see Fig. 2).

No significant correlation was found when the home range sizes of the clans were compared to the average distances to peripheral cavity trees of neighboring clans ($r = 0.78$, NS). However, when home range sizes were compared to the average distances between the nest cavities of all surrounding clans, a significant relationship was found ($r = 0.95$, $P \leq 0.05$). Hence, it appears that the further away the nest cavities of neighboring clans, the larger the size of the home range.

One possible explanation for the relationship between the proximity of nest cavities and home range size is that aggression by members of a clan toward intruders decreases as the distance from their nest cavity increases. When nest cavities are close together, movements of a clan are limited by aggression encountered from neighboring clans in areas surrounding their respective nest cavities. When nest cavities of neighboring clans are not in close proximity, a clan can expand its home range over a larger area without encountering agonistic interactions. By comparing Figs. 1 and 2, we see that where home ranges of clans 2–4 extend toward the nest cavities of their neighbor clans, the number of agonistic encounters is high. The nest cavity of clan 1 is more isolated from neighboring nest cavities than the nests of clans 2–4 and this isolation may explain the small number of agonistic encounters recorded for this clan and its large home range. Hence, we feel that a clan's defense of its nest cavity is a major factor in limiting the range of adjacent clans. This hypothesis is congruent with the suggestion of Hooper et al. (unpubl.) that the territories, or defended areas, of 6 red-cockaded clans were smaller than their home ranges and would also strengthen the argument for the importance of the nest cavity as the central focus of the clan (Ligon 1971).

SUMMARY

The average size of the winter home ranges of 4 clans of Red-cockaded Woodpeckers in the Carolina Sandhills National Wildlife Refuge was 31.2 ha. Distance between nest cavities of clans appears to be significantly related to the sizes of the home ranges of the 4 clans. No significant relationship was found between home range size and clan size, agonistic encounters or distances to peripheral cavity trees. Future research involving a larger sample size will clarify whether these factors may play a role in influencing home range size. The relationship between nest cavity distances and home range size does indicate that interclan

pressure is a major factor influencing the home range size of 4 clans of Red-cockaded Woodpeckers in the Carolina Sandhills National Wildlife Refuge.

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